RESTORATION OF A FORESTED WETLAND, STONE MOUNTAIN CREEK, DEKALB COUNTY, GEORGIA

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REFERENCE: Proceedings of the 1991 Georgia Water Resources Conference, held March 19 and 20, 1991, at The University of Georgia. Kathryn J. Hatcher, Editor, Institute of Natural Resources, The University of Georgia, Athens, Georgia, 1991.

INTRODUCTION

The Environmental Protection Agency issued an administrative order to Georgia's Stone Mountain Park in November, 1989, for violation of Section 301(a) of the Clean Water Act. The order cited the Park for "causing the discharge of pollutants into waters of the United States without a permit." The park had participated in dredging a new channel for Stone Mountain Creek without first obtaining a Section 404 permit for discharge of fill material into waters of the United States. Specifically, dredge spoil had been deposited in wetlands adjacent to the creek.

The administrative order mandated that Stone Mountain Park restore the disturbed wetland. In particular, EPA required that Stone Mountain Park remove fill from 0.7 acres, recommended fill removal from an additional 0.9 acres, recommended that all exposed soils be stabilized as soon as possible, and required that all cleared areas be revegetated with wetland tree species (total of 2.5 acres). EPA also required monitoring of the vegetation and hydrology and development of a contingency plan to implement corrective measures, if necessary. This paper describes the planning, implementation, and results of the restoration effort.

PLANNING

In January, 1990 WAPORA, Inc. and Wetland Research Associates, Inc. began developing a restoration plan to satisfy EPA requirements. The following factors were considered:

- Pre-existing Environment- Prior to disturbance, beaver activity and heavy siltation in the creek valley had increased flood frequency and duration and killed most of the trees. Approximately 15 acres along the creek were probably semipermanently flooded to seasonally saturated scrub-shrub wetland. However, up to 1.7 acres of the disturbed area may not have been wetland prior to filling.
- Impacts of the Dredge and Fill- 3.8 acres of floodplain were directly disturbed by dredging, clearing, or filling. Additionally, the dredging increased flow rates through the basin, partly drained nearby wetlands, and decreased the frequency and duration of floodplain inundation.
- Impacts Resulting from Restoration- Alteration of the flooding characteristics was a major concern. The channel had been dredged, in part, to reduce flooding of adjacent residential property. Also, the need for a floodway alteration permit was explored. Ultimately, EPA agreed that restoration of the pre-existing hydrology could be accomplished only by replacement of the dredge spoil into the dredged channel. Because of the great potential for causing further adverse flooding and sedimentation impacts, restoration of the pre-existing hydrology was not required. Fill removal from several areas would have required additional clearing of vegetation. Therefore, EPA did not require fill to be removed from these areas.
- Potential for Success- Few trees native to the Piedmont are adapted to semipermanently flooded areas. Therefore, allowing the dredged channel to remain probably would increase the survival of planted trees. It was expected that natural revegetation of herbs and shrubs would take several growing seasons. The return of beaver to the area and continued sedimentation from upstream development was expected. It was anticipated that some long term maintenance, such as weeding and erosion control would be required.
- Implementation logistics- It was agreed that Stone Mountain Park would provide materials and labor for most of the restoration effort. The commercial availability of several tree species was uncertain. Also, planting was expected to begin in mid-spring, past the optimal time for tree planting. The only access to the site was through private property, and certain concerns of the landowner would have to be accommodated in order to gain access.

In February and March, the disturbed area was surveyed, depths of fill were measured, the flooding characteristics of the basin were observed, and a specific fill removal and tree planting plan was developed.

IMPLEMENTATION

In April, 1990, implementation of the restoration plan began. Fill was removed from 1.1 acres on the northern and western banks of the creek (Figure 1). Excavation ceased as soon as the buried root mat was observed, because it was believed that the benefit of natural resprout would outweigh any adverse impact of incomplete fill removal. Where fill was removed, streambanks were graded to at least a 3:1 slope. The streambank along one section of undredged channel (power line right-of-way) also was graded in order to minimize erosion and allow increased floodwater conveyance. Difficulty arose when the adjacent landowner threatened to refuse further access. As a compromise, EPA approved spoil disposal in an intermittent tributary ravine. A culvert was installed, and the ravine was filled to a depth of about 5' with the remaining spoil. The banks were rip-rapped where the culvert emptied into the main creek channel. In areas where fill was allowed to remain, no grading or grubbing was implemented.

Tree planting began in areas that had only been cleared or where fill was allowed to remain. Planting proceeded into other

areas as the fill was removed. The final area was planted on 20 April 1990. A total of 1200 trees were planted in 2.2 acres. Bare root seedlings, 1.5'-2.5' tall, of seven hydrophytic tree species were planted: sweetgum (*Liquidambar styraciflua*), river birch (*Betula nigra*), water oak (*Quercus nigra*), willow oak (*Quercus phellos*), red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), and green ash (*Fraxinus pennsylvanica*). A mix of species was planted in each area. However, river birch and green ash were concentrated on streambanks, red maple and green ash were concentrated in an area expected to be seasonally saturated, and sweetgum and sycamore were concentrated on the higher ground. No fertilizer or other soil preparation was used, but all trees were staked. Because planting occurred over two weeks, some trees were in and out of cold storage several times. No trees were planted on 0.6 acres of power line right-of-way. Slopes were planted with winter rye, and the power line right-of-way was seeded with fescue. No other herbaceous or shrubby plants were introduced.

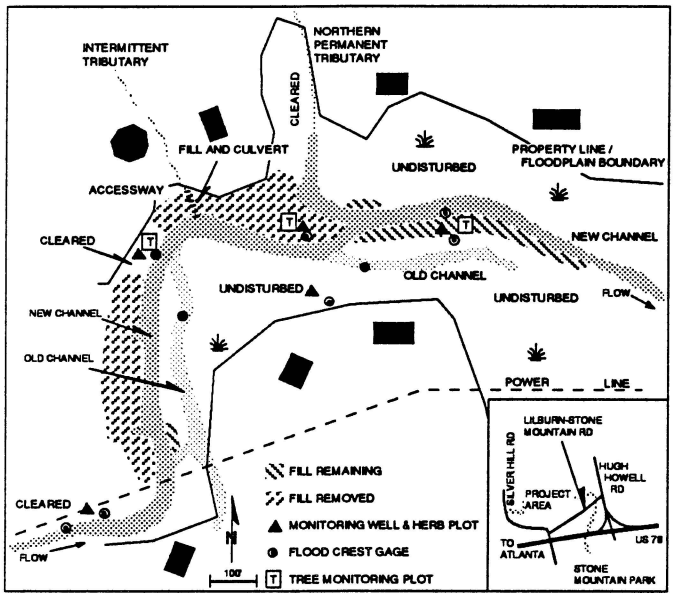

Figure 1. Stone Mountain Creek wetland restoration site. All disturbed areas were plated with trees except power line.

Monitoring stations were established in May. Twenty five trees were tagged at three locations in order to monitor the success of the planting. Natural resprout was monitored by marking 5'x5' plots at one undisturbed and four disturbed locations. Groundwater monitoring wells were installed at four locations in the disturbed area and in one location in the undisturbed floodplain. Wells were hand augered to an average depth of 11' and screened for the entire length. Rain gages were installed on two wells, and all wells were marked so erosion or sediment deposition could be measured. Crest-stage gages similar to those described by Buchanan and Somers (1968) were installed at nine locations throughout the floodplain and channels. Initially, vegetation was to be monitored monthly and hydrology monitored weekly.

RESULTS

Natural resprout of black willow (*Salix nigra*), jewelweed (*Impatiens capensis*), dayflower (*Commelina virginica*), soft rush (*Juncus effusus*), smartweeds (*Polygonum* spp.), and sedges (*Carex* spp.) was first observed in mid-March. Maximum vegetative growth was observed in late September. Natural resprout resulted in 100% herbaceous cover in all but the driest areas. Species diversity was excellent; over 50 species were identified. Two species are DeKalb County records, green dragon (*Arisaema dracontium*) and mud plantain (*Heteranthera reniformis*). DeKalb is one of only four Georgia counties for which mud plantain is recorded. Resprout of black willow, alder (*Alnus serrulata*), and silky dogwood (*Cornus amomum*) has occurred throughout the site.

Monitoring tree growth was difficult due to the thick herbaceous cover. By August, less than half of the tagged trees could be located, and tree monitoring was abandoned until winter. Initial results revealed the following trends.

- Sweetgum exhibited poor initial survival; probably many trees were dead when planted. Survival may be related to either location or time of planting; those planted latest had the highest survival rate.
- River birch was very slow to put out leaves. As many as 50% may have died; growth of the survivors was barely noticeable.
- Most water oak and willow oak appeared to die, but then resprouted from the base. Current survival is estimated to be around 75%.
- Red maple, sycamore, and green ash achieved almost 100% survival and rapid growth; several trees were close to 6' tall after one growing season.

In general, tree growth was best where there was shade and consistently moist soil. Tree growth and natural revegetation was noticeably retarded on an exposed, excessively drained terrace, 5' above the creek. After September, many seedlings were flattened under mats of dead vegetation, especially along flood-prone streambanks.

Depth to groundwater ranged from 2'-5.5' depending upon well location. Weekly groundwater levels were consistent except in the well in the undisturbed floodplain, where levels ranged from 2'-4'. Groundwater was never observed higher than 1.7' below land surface at any time, in any well.

In general, 2" of rain, falling in a 4 to 8 hour period is required to inundate most of the restoration area and adjacent undistrubed floodplain. This amount of rain fell six times from January through October, but only a few small puddles had standing water one week after a flood. Several gages were bent by the force of the floodwaters, and several became clogged with silt. The gradient in the upstream third of the creek appeared to be stable; the creek wandered between its banks, but did not cut deeper. The middle third of the dredged stream reach underwent further incision. Sediment was deposited in the downstream third of the dredged channel. Small natural levees formed along some sections of the creek. In other areas, stream banks were eroding as the creek carved a sinuous path out of the straight dredged channel.

The intermittent tributary ravine that was filled and culverted was eroding at its confluence with Stone Mountain Creek. Runoff flowing down the ravine on top of the fill, location of the culvert mouth too high above the main creek, and severe flooding all contributed to the erosion. In October, a

small beaver dam was constructed across the northern tributary, just above the confluence with Stone Mountain Creek. The adjacent landowner has dumped trash into the restoration site and manipulated adjacent drainage without regard for impacts outside of his property.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE WETLAND RESTORATION EFFORTS

Based on the initial monitoring, the following conclusions can be drawn and corresponding recommendations can be made:

- Natural revegetation was much more successful than originally predicted. Herbaceous hydrophytes sprouted from seeds in the alluvium. Shrubby hydrophytes resprouted from roots and limbs. Care should be taken to avoid grading into the original A horizon so that natural revegetation can be maximized. Best herbaceous growth occurred in direct light where soils were moist.
- Areas in direct sunlight or that are excessively drained should be lightly mulched with straw as soon as the ground is prepared. This will retain moisture and reduce erosion, but not inhibit natural resprout or tree planting.
- Bare root seedlings are an effective and cheap method of tree planting. Planting can continue through late April if the weather is cool and damp. In general, newly planted seedlings grow best in shaded areas with moist soil.
- The suitability of sweetgum, river birch, willow oak, and water oak for bare root planting must be further evaluated. Bare root seedlings of red maple, sycamore, and green ash exhibited good survival.
- Some tree mortality is inevitable due to flooding, poor stock, competition, or other factors. Because of the low cost of bare root seedlings, overplanting may be an effective way of insuring success. Some maintenance clearing may be required so that herbs and shrubs do not choke the seedlings.
- A stream and its floodplain are composed of numerous sedimentary environments, and deposition, erosion, and channel migration are constantly occurring in different locations. Observations regarding erosion and deposition apply only to the specific measuring point.
- A wetland hydrologic regime was not present during the summer. However, the area may revert to its pre-existing hydrology through beaver modification and natural alteration of the dredged channel. When possible, a restoration plan should carefully consider the benefits of allowing a wetland hydrologic regime to return naturally, rather than through manipulation.
- Culverting and filling the intermittent tributary ravine was a mistake. Rip-rap is an ineffective method of preventing streambank erosion by either runoff or floodflow. Pre-existing drainage patterns should be preserved if at all possible.
- The final restoration effort differed from the originally proposed plan. Any plan must be flexible enough to accommodate unexpected conditions encountered during implementation. Also, compromises must be reached when various goals of a project require conflicting conditions (e.g. beaver will reinstate a wetland hydrologic regime, but will also destroy many planted seedlings).
- Natural landscape evolution should not be confused with failure. Factors such as beaver, channel migration, or a changing sedimentary environment may be beyond anyone's control. Planners and regulatory agencies must be prepared to compromise in order to accommodate natural forces.
- The most serious hindrance to successful implementation of the restoration plan was the adjacent landowner. In some cases, legal agreements will be required in order to gain and maintain access across private property.
- The burden of insuring success and preventing further impacts to the project area lies with Stone Mountain Park rather than regulatory agencies.

So far, the restoration of the Stone Mountain Creek floodplain appears to be successful. Hydrophytic vegetation has been established, and a wetland hydrologic regime may develop as the stream channel matures or beaver return. The success of the bare root seedlings is encouraging with regard to future restoration and creation of forested wetlands on Piedmont floodplains.

LITERATURE CITED

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